Ecosystem Restoration

Ecosystem restoration is the activity of improving the condition of our modified natural landscapes and biotic communities to provide for the sustainability and for the use and enjoyment of those ecosystems by current and future generations. Healthy aquatic and wetland ecosystems benefit California's native plant and wildlife populations and provide valuable goods and services that support our society and economy. Ecosystem restoration can include instream flow changes, habitat restoration, physical modification to water bodies, control of waste discharge in waterways, exotic species control, removal of barriers to anadromous fish migration, land and water acquisitions, and fire management.

California's ecosystems cannot be restored to the natural state, or even to pre-Gold Rush conditions. Instead, ecosystem restoration focuses on the rehabilitation of ecosystems so that they supply important elements of their original structure and function in a sustainable manner. Ecosystem protection and restoration should be viewed as the proper maintenance in a sustainable manner of California's natural infrastructure, with recognition of the importance of that infrastructure to the future of this state. Ecosystem restoration is included among the water management strategies in *Water Plan Update 2003* because it is linked with improvement of water supply reliability, and also because it is an important consideration for water managers as they pursue integrated resource management.

Over the past decade, the public has recognized the need to restore California's ecosystems, largely as a result of the public's awareness of the value of healthy rivers and other aquatic ecosystems. The desire to improve the conditions of those ecosystems was supported by the passage of bond issues, such as Propositions 204, 13 and 50. Local and regional restoration projects have multiplied in number. Hundreds of watershed alliances and regional ecosystem projects are in place throughout the state. Major river restoration projects are under way in every corner of the state, including the Los Angeles, San Joaquin, Truckee, Carmel, Sacramento, and Trinity Rivers, to name a few. Some of these projects are described in the regional reports of Volume 2.

The decade prior to publication of this update saw a remarkable transformation in water management in California. In 1993, water management was characterized by lawsuits, policy gridlock, and conflicts between those who sought to improve water supply reliability and those who sought to protect threatened and endangered species. Since then, the California Bay-Delta Program has served as an example of integrated resource management – improving water supply reliability while simultaneously restoring ecosystems – and seems far more likely to succeed than single-purpose pursuits.

Water development projects in the past have often had significant, if unanticipated, environmental impacts. Today, planning must include front-end investment to prevent ecosystem damage and long term maintenance costs. Future water management efforts could face conflict and opposition unless these efforts are accompanied by actions that contribute to the protection and restoration of ecosystem health. This strategy focuses on restoration of aquatic ecosystems because these are the ecosystems most likely to be affected by the actions of water projects. Furthermore, water projects play a critical role in the restoration of aquatic ecosystems because they can help ensure appropriate water supply, flow rate or flow pattern to facilitate restoration actions.

State water managers also have an important public trust responsibility to protect waters of the state for their environmental, recreational, and aesthetic values. Other strategies described in this chapter that

relate closely to ecosystem restoration and public trust responsibilities include floodplain management, pollution prevention, matching water quality to use, and water-dependent recreation.

Ecosystem Data

Information on restoration projects, biological resources, and organizations involved in restoration can be found for many parts of the state. The Information Center for the Environment (ICE) is a cooperative effort of environmental scientists at the University of California, Davis, and collaborators at more than 30 private, state, federal, and international organizations interested in environmental protection. ICE has developed the Natural Resources Projects Inventory, a database of information on thousands of conservation, mitigation and restoration projects being developed and implemented throughout California. Also, the California Environmental Resources Evaluation System is an information system developed by the Resources Agency to facilitate access to a variety of electronic data describing California's rich and diverse environments. The California Legacy Project, a part of CERES, has supported conservation investment decisions in numerous ways, including: (1) identified a long-range strategy to conserve the most important natural resources in California; (2) assembled a digital atlas of key resources and stressors; and (3) reported on the status and trends of those resources.

Current Condition of California's Ecosystems and Restoration Activity

California Rivers, A Public Trust Report (State Lands Commission, 1993) concluded that the health of California's rivers is stressed and their viability as sustainable ecosystems is in peril. The report urged state agencies to undertake a comprehensive program of river basin and watershed protection and restoration. The same conclusions apply to many of California's other aquatic ecosystems, including bays, estuaries, and lakes. The condition of California's fisheries reveals the need for extensive improvement. Thirty-three fish populations are listed as threatened or endangered in California, with some in each of the hydrologic regions described in Volume 2. These populations include coastal and Central Valley runs of steelhead; spring-run and winter-run Central Valley Chinook salmon; Delta smelt; three species from the Colorado River; and several minnows, pupfish and suckers from the Klamath basin and southern deserts.

California's ecosystems, particularly aquatic ecosystems, have been significantly modified over time. Hydraulic mining and gold extraction in the 1800s, dam construction and operation, pollution, flood control, urbanization, increases in Delta exports and upstream diversions, and introduction of exotic species have all contributed to the decline in ecosystem health. Ecosystem changes have caused a sharp decline in the abundance of things that society values, such as native and some non-native fish species. Ability to sustain various life stages of native fish is an example of a function that California rivers no longer provide as well as they once did. Human activities have also affected the structure of ecosystems. For example, rivers downstream of dams are deprived of the gravel supply from upstream that provides spawning habitat for species such as Chinook salmon.

One significant ecosystem stressor is the unintended impact of actions that we intentionally take. The California Environmental Quality Act recognizes that human activity may have unintended environmental impacts, and outlines procedures for project proponents to avoid, minimize, and mitigate these impacts. Mitigation for environmental impacts has become a common practice in California. Mitigation is similar to ecosystem restoration, but mitigation is intended to bring the level of ecosystem health back to what it

was before impacts of a project occurred. By contrast, ecosystem restoration is intended to raise the level of ecosystem health.

Water projects can fall into this category of ecosystem stressors, and are usually controversial because of their unintended environmental impacts. It may not be possible to fully mitigate for the impacts of these projects. When impacts occur in aquatic ecosystems that are already severely degraded, it may be difficult to avoid endangered species conflicts or to build societal support for the project. Unlike other stressors whose impacts cannot be avoided, such as past damage from hydraulic mining, urbanization or introduced species, water projects can be stopped if society deems the environmental impacts to be unacceptably high. This is the situation that has often faced water managers in California over the past several decades. Water projects, including both large-scale projects such as the construction of major dams or increased exports through the Delta, as well as small local projects, have become the focus for opposition based on the projects' potential for environmental impacts.

More recently, resource managers have concluded that the most successful way to pursue either aquatic ecosystem restoration or water management is to integrate the two. This integration of project goals has the potential to reduce the conflict over water management actions, increase the support for ecosystem restoration and provide a more cost effective solution.

Beyond the pragmatic consideration of incorporating ecosystem restoration into water projects to increase the chance of success, water managers face a responsibility to protect waters of the state under the public trust doctrine. The public trust is a concept rooted in common law, stating that the state has the responsibility to hold certain resources in trust for the people and to exercise continuing supervision over these resources. Thus, it may not suffice to protect a natural resource in its current condition, if that condition represents a state of decline. Courts have upheld the public trust doctrine and affirmed the responsibility of resource managers to protect public trust values whenever feasible.

Within state government, several departments and boards share public trust responsibilities. The Department of Fish and Game coordinates, oversees, funds, and carries out restoration activities and plays a central role in carrying out public trust responsibilities. The State Water Resources Control Board regulates water rights and establishes standards for minimum stream flows. The Department of Water Resources, as the operator of the State Water Project, can propose, design, build, and operate water management facilities in ways that improve water supply reliability while restoring ecosystem health and protecting public trust values. No one of these agencies can be completely successful unless there is collaboration among all. See Volume 1, Chapter 2, for details on the public trust doctrine and values.

Benefits of Ecosystem Restoration

Restoration can result in improved flora and fauna condition, increased diversity and connectivity of habitat, recovery of endangered species, and improved watershed condition and trends. Restoration efforts can rehabilitate natural processes to support native communities with minimal ongoing human intervention. Restored functional habitats are likely to sustain reproduction, foraging, shelter, and other life stage needs of a community of fish and wildlife species. By setting our goals high – at the ecosystem level, rather than recovery of a handful of species – we improve our chances for long-term success by incorporating species relationships, such as between predators and prey, physical processes, genetic variability, and other factors that we don't fully understand.

The state's ecosystems, from mountain watersheds to coastal beaches, are California's natural infrastructure, and support our population and economic growth. Ecosystem restoration is an investment in improving the condition of California's natural infrastructure. As our understanding of the linkage between water management and the health of the natural infrastructure grows, the benefits of restoration to water supply reliability and water quality improvements are increasingly evident. As ecosystem restoration actions help increase the health and abundance of species currently protected under the state and federal Endangered Species Acts, there will be fewer ESA conflicts. As ecosystems such as wetlands and sloughs are restored, their natural pollutant filtering capabilities will improve water quality. As floodplains and seasonal lakes and ponds are restored, groundwater recharge can increase. The result will be a more reliable, higher quality water supply supported by a sustainable ecosystem.

The economic benefits that improved rivers, estuaries, wetlands, wildlife, beaches, and their surrounding habitats can have in the state may far exceed the investments for restoring ecosystems. Considering California lifestyle trends and travel and tourism as the major growth industry for the state, investments in ecosystem restoration actions may provide a high return on investment.

California's recreation and tourism industry – at $75 billion a year – is one of the state's largest industries. Next to the state's beaches, rivers are the second biggest attraction for California's recreation industry. Similarly, managed wetlands and wildlife refuges provide bird watching and hunting opportunities that contribute hundreds of millions of dollars annually to California's economy.

Costs of Ecosystem Restoration

A statewide summary of ecosystem needs and their costs does not exist. However, it is likely that the costs of restoration are higher than the costs of protecting existing healthy ecosystems. Costs of restoration can include research and monitoring, acquisition of land and water, cultivation and planting of native vegetation, and physical alteration of the landscape. The costs of river restoration can increase dramatically when channel alteration is required, such as filling in gravel pits or re-grading incised banks.

California voters have recently approved three bond issues that include funds to restore animal and plant life. As of the end of 2003, the California Bay-Delta Program has funded 400 projects at a cost of $490 million, and has committed $150 million per year toward ecosystem restoration.

Supplying water for ecosystem needs is often viewed as competing with supplying water for human needs, or responsible for increasing the cost of supplying human needs. While there are limits to the amount of water that can be withdrawn from a river ecosystem before its health and productivity are compromised, experience with integrating ecosystem restoration and water supply management is demonstrating their compatibility in many cases. As an example, in years 2001 through 2003 the Environmental Water Account of the California Bay-Delta Authority acquired about 900,000 acre-feet of water, at a cost of about $140 million, to protect at-risk fish species.

Major Issues Facing Implementation of Ecosystem Restoration

The major threats to aquatic and riparian habitat and freshwater biodiversity in California stem from physical changes associated with on-stream dams, diversions, levees and bank armoring; poor water quality, including temperature, dissolved oxygen levels and pollutants; and non-native invasive species. These issues are outlined further in the strategies for floodplain management, pollution prevention and

watershed management in this chapter. Beyond those direct physical changes, this section describes other issues and challenges facing restoration efforts.

Integrated Resources Planning

Unlike single-purpose planning, project designs that incorporate diverse interests can take longer, cost more and require better knowledge of key ecological elements and processes.

Assessment of Environmental Flows

Knowledge of effects of different flows on the health of aquatic and riparian ecosystems is incomplete. Data and analytical tools to measure the adequacy of flows are insufficient.

Scientific Uncertainty

Restoration science is a work in progress. Rarely do we have all the scientific information on a species, much less an ecosystem, to identify an exact course of action that will restore natural communities and processes. When precious resources and endangered species are involved, we often do not have the time or money to fully develop our scientific understanding before action is needed. Yet, the uncertainty can lead to hesitation and delay.

Sound, Accessible Data

There is no complete inventory of ecosystems and their health. Key criteria to prioritize conservation actions are lacking, scattered or incompatible for comparison. There is also no reporting system and incomplete metrics for evaluation of the outcome of various restoration and management strategies. This is necessary for more efficient investment of public funds.

Effectiveness and Efficiency of Restoration Actions

The previous issue statements make it clear that assessment of the effectiveness and efficiency of actions taken to restore and protect aquatic ecosystems is often complex and difficult. Effectiveness is the amount of benefit gained (e.g., an increase in abundance of a species). Efficiency can be thought of as the effectiveness per unit of expenditure (e.g., money or water). Effectiveness and expenditure may not correspond one-to-one, often because factors other than the applied money and water influence the degree of restoration achieved. The perception of wide variations in efficiency motivates a search for the more efficient alternatives. Without agreement on which alternatives those might be, opposition to further commitments, especially of water, will continue.

Funding Uncertainty

Ecosystem restoration efforts are often long-term and need long-term financing. Although public funds are available, they may be sporadic and thus unreliable, and are subject to intense competition. In contrast, water supply projects could rely on user fees to recover costs.

Gravel and Sediment

Dams retain sediment, including gravel, which is a critical element in river ecosystems. Furthermore, conventional bank protection prevents the erosion that could provide a local supply. Without a natural mechanism for replenishment of sediment, gravel must come from elsewhere. Locating sediment sources, mining gravel without causing more environmental damage and paying for long-term sediment management are significant challenges to restoring the natural functions and values of rivers below large dams.

Recommendations for Ecosystem Restoration

1. DWR, DFG and SWRCB should work together to publish comprehensive assessments of in-stream flow needs on California rivers, similar in scope to studies on the Feather and American rivers. The assessments should identify bodies of water that need improved flows, in terms of volume, timing, duration, etc.
2. The Resources Agency and Cal-EPA should work with their respective departments, boards and commissions to ensure and promote independent science in decision-making.
3. The Resources Agency should continue to support development and use of statewide databases, analytical tools and evaluation criteria, such as the Natural Resource Project Inventory and a follow-up to the Legacy project, that can provide information to planners and decision-makers and identify priorities for restoration. This investment should provide a coordinated and comprehensive statewide implementation plan for restoration actions in each region.
4. The Resources Agency should support further scientific research on the relationship between flow dedication and water-independent actions to achieve desired restoration. A step in this direction was the publication of a report by Deason et al. (2004) of the Graduate School of Public Policy at UC Berkeley, "Considering water use efficiency by the environmental sector." The report (see Volume 4) identifies ways to measure and compare—albeit in general terms—the efficiency of different uses of managed environmental water.
5. The Department of Fish and Game, with the Department of Conservation and DWR, should investigate and resolve key issues regarding long-term coarse sediment supplies for ecosystem needs. This investigation should identify sources of sediment, replenishment processes that will sustain themselves and potential mercury contamination.

Integrated Resources Planning

DWR will incorporate ecosystem restoration as an objective in water management projects, or will partner with restoration projects, to achieve net environmental benefit from water management actions. This is consistent with the commitments that DWR has made in the California Bay-Delta Program. DWR will develop guidelines for helping local water managers and planners pursue the same multiple-objective approach, including incorporation of fish and wildlife benefits into projects. See Volume 1, Chapter 2, for more recommendations to promote integrated resource planning.

Funding

As part of the FY 03-04 Budget, the Department of Finance proposed and the legislature adopted the following Budget Bill text: "It is the intent of the Legislature that the California Bay-Delta Authority submit a broad-based Bay-Delta user fee proposal as part of the 2004-05 Governor's Budget, consistent with the beneficiary-pays principle specified in the CALFED Record of Decision."

Such a fee was described in the Implementation Plan appendix to the CALFED Record of Decision, which said "For the Ecosystem Restoration Program, the CALFED agencies propose a combination of State funding (including Proposition 204 funds), Federal funding, and user fees…the CALFED agencies will work with local interests to develop State legislation to create a broad-based user fee that will generate approximately $35 million annually."

Information Sources

- California State Lands Commission. 1993. California Rivers, A Public Trust Report. 334 p.
- California Department of Fish and Game. 2003. California's Plants and Animals. http://www.dfg.ca.gov/hcpb/species/t_e_spp/tespp. shtml
- CALFED Bay-Delta Program. 2000. Strategic Plan for Ecosystem Restoration. x, 73 p.